Analysis of ^{99}Technetium through accelerator mass spectrometry techniques (Arctic and Pacific Ocean)

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Technetium-99 is a long-lived radionuclide fission product of Uranium with a half-life of 211,000 years produced artificially through nuclear waste emissions. Enhanced actinide removal plants (EARP) are the main Technetium-99 producers in Western Europe. As one of the only two elements known to exist without a stable isotope ^{99}Tc is treated as a conservative oceanographic tracer. This study provides insight into recently developed accelerator mass spectrometry (AMS) techniques for measuring ^{99}Tc at the femtogram level. Pacific and Arctic Ocean water samples were prepared using a standard dilution series with varying amounts of ^{99}Tc. The initial procedure established the optimum target composition in order to maximize the sensitivity of the measurement technique. This tested the direct proportionality between the AMS ion count rate and the concentration of Technetium-99 assessed in the samples. AMS techniques must ensure that Ruthenium-99 interference is negligible. Therefore individual samples were spiked with varying amounts of pure niobium powder in order to test the effectiveness of niobium at supressing the interference of the ^{99}Ru isobar. The results of this study show that the ^{99}Ru interference was negligible. This indicates that the sample matrix and instrument normalization solely requires lead fluoride as a ^{99}Ru suppressant without the need for niobium. Optimum results were observed by PbF_2/FeO_x ratios of 1:10 over 1:5. A dilution series delivered viable measurements using standard solutions which allowed for further experimentation on the validity of sample preparation using a seawater matrix. Iodine-129 and Caesium-137 present in the North Sea will assist in estimating the concentration of ^{99}Tc, since the source of both isotopes are from nuclear fuel reprocessing. The extractions are performed in two volumetric quantities of 50 mL and 200 mL in order to test that the experimental procedure is independent of the volume of seawater used in the extractions. Secondary experimental procedures concern the use of rhenium as a chemical yield tracer for ^{99}Tc extraction and precipitation. This will introduce a substitute chemical yield tracer other than Technetium-99m.